ABUNDANCE AND RUN TIMING OF ADULT SALMON IN THE EAST FORK ANDREAFSKY RIVER, YUKON DELTA NATIONALWILDLIFE REFUGE, ALASKA, 1996

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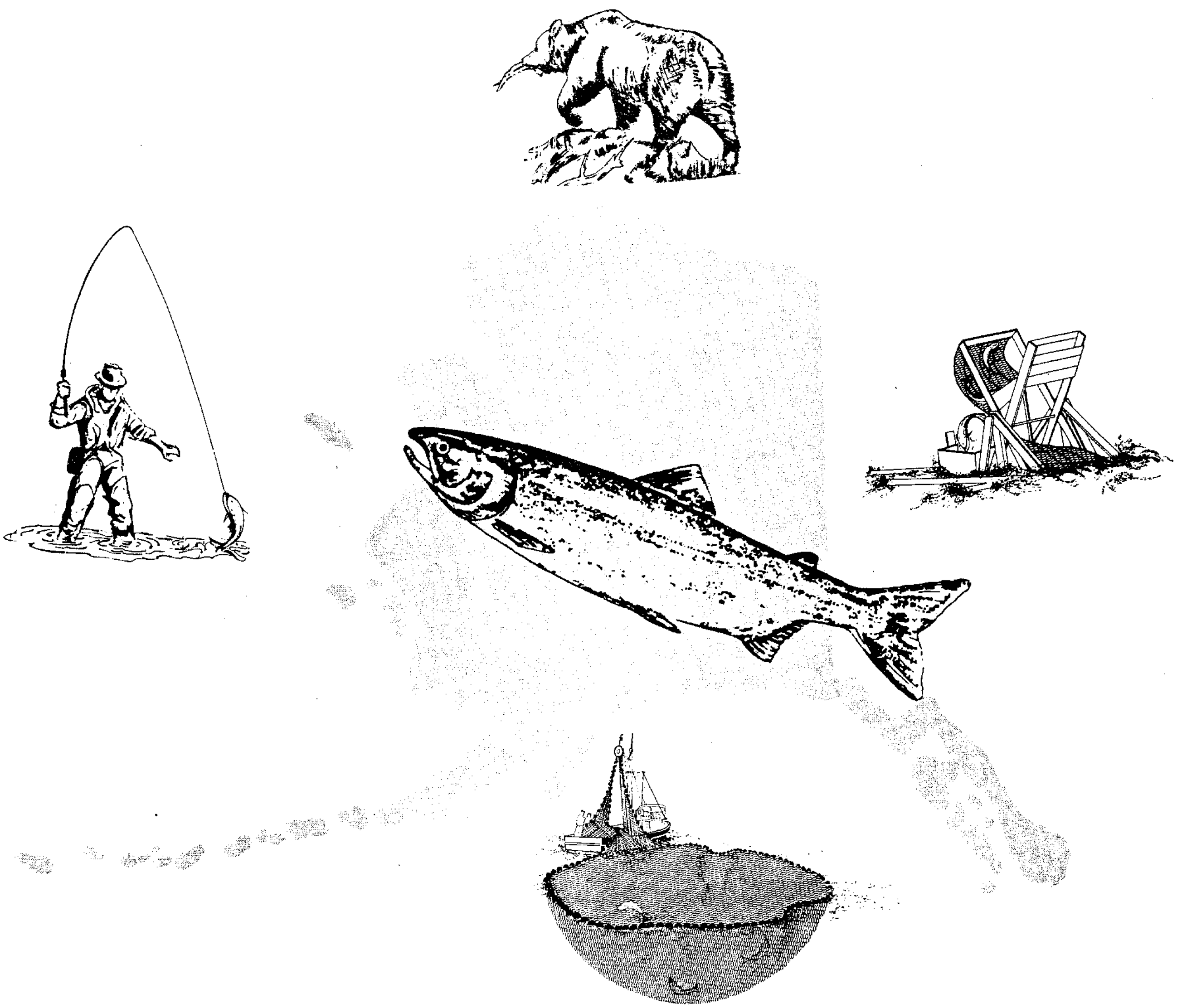

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Abundance and Run Timing of Adult Salmon in the East Fork Andreafsky River, Yukon Delta National Wildlife Refuge, Alaska, 1996

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Abstract.— From June 19 to September 16, 1996, a resistance board weir was used to collect abundance, run timing, and biological data from salmon returning to the East Fork Andreafsky River, a tributary to the lower Yukon River. This was the third of a five-year study initiated to provide reliable data necessary for managing refuge fishery resources that contribute to major commercial and subsistence fisheries.

A total of 108,450 chum *Oncorhynchus keta*, 2,955 chinook *O. tshawytscha*, 214,837 pink *O. gorbuscha*, 248 sockeye *O. nerka*, and 8,037 coho *O. kisutch* salmon were counted through the weir. Picket spacing (4.8 cm gap) was wide enough for pink salmon to escape upstream undetected. Peak weekly passage occurred: June 30-July 6 for chum; July 7-13 for chinook; July 14-20 for pink; July 7-13 for sockeye; and August 25-31 for coho salmon.

Four age groups were identified from 1,277 chum salmon sampled from the weir escapement between June 19 and September 7. This escapement was composed primarily of age 0.3 (59%) and 0.4 (35%) fish. Females composed an estimated 50% of the sampled chum salmon escapement and were predominate during the month of July. Age composition was similar between sexes.

The 1996 weir escapement of 108,450 chum salmon was less than in 1994 (N=200,981) and 1995 (N=172,148). Fish from the 1991 brood year appeared to return in weak numbers at ages 0.3 and 0.4 during 1995 and 1996. Except for an early pulse of fish, run timing during 1996 resembled that in 1994 and 1995.

Six age groups were identified from 340 chinook salmon sampled from the weir escapement between June 30 and September 6. This escapement was composed primarily of age 1.3 (77%) and 1.4 (12%) fish. Males composed an estimated 59% of the sampled chinook salmon escapement and predominated except during the first week of July. Males were predominately age 1.3 (84%), and females were primarily age 1.3 (66%) followed by age 1.4 (21%).

The 1996 weir escapement of 2,955 chinook salmon was less than in 1994 (N=7,801) and 1995 (N=5,841). Strong 1991 brood year returns of age 1.2 fish in 1995 and age 1.3 fish in 1996 indicate a potentially strong age 1.4 component in the 1997 East Fork return. Run timing during 1996 resembled that in 1994 and 1995.

Three age groups were identified from 316 coho salmon sampled from the weir escapement between August 20 and September 9. Males composed an estimated 54% of this escapement and predominated through August. Age 2.1 coho salmon were most abundant (97%).

The 1996 weir escapement of 8,037 coho salmon was less than in 1995 (N=10,901). Run timing during 1996 resembled that in 1995.

Eleven Dolly Varden *Salvelinus malma*, 3,724 whitefish (*Prosopium cylindraceum* and *Coregonus* spp.), and 125 northern pike *Esox lucius* were counted through the weir. Only larger sized resident species are represented because of picket spacing.

Introduction

The Andreafsky River is one of several lower Yukon River tributaries on the Yukon Delta National Wildlife Refuge (Refuge). The main stem Andreafsky River and its primary tributary, the East Fork, provide important spawning and rearing habitat for chum *Oncorhynchus keta*, chinook *O. tshawytscha*, pink *O. gorbuscha*, sockeye *O. nerka*, and coho *O. kisutch* salmon (USFWS 1991). It supports the largest return of pink salmon in the Yukon River drainage and typically ranks second to the Anvik River in summer chum salmon (arbitrarily determined as those in the escapement prior to August 1) escapement and second to the Salcha River in chinook salmon escapement (Sandone 1989). Andreafsky River salmon also contribute to a large subsistence fishery and pass through two commercial fishery districts between the Yukon and Andreafsky River mouths (Bergstrom et al. 1995).

The Alaska National Interest Lands Conservation Act (ANILCA) mandates that salmon populations and their habitats be conserved within the Refuge, international treaty obligations be fulfilled, and subsistence opportunities for local residents be provided. Salmon escapement studies for lower Yukon River tributaries on the Refuge and the endeavor to fulfill obligations included in the U.S./Canada Interim Yukon River Agreement are ranked as priorities in the Refuge Fishery Management Plan (USFWS 1991). Compliance with ANILCA mandates, however, is not ensured when reliable data on Refuge originating stocks are not available.

Adequate escapements to individual tributaries and main stem spawning areas are required to maintain genetic diversity and sustainable harvests, but management is complicated by the mixed stock nature of the Yukon River fishery. Managers attempt to distribute catch over time to avoid over-harvesting individual stocks as each may have distinct migratory timing (Mundy 1982). Stocks or species returning in low numbers or early and late portions of runs may be over-harvested incidentally during intensive harvesting of abundant stocks. Escapement data are lacking on many of these individual stocks in the Yukon River drainage and are needed for more precise management.

Relative abundances of summer chum, chinook, and coho salmon have been estimated in the Andreafsky and other tributary rivers on a limited basis by the Alaska Department of Fish and Game (Department) using aerial index surveys (Bergstrom et al. 1995). These surveys are usually conducted after salmon are on the spawning grounds thus too late for making management decisions that affect escapement. Weather delays and poor visibility also reduce the accuracy of some aerial index surveys. Even if conducted during optimal conditions, these surveys provide only a relative index of abundance and tend to underestimate escapement (Bergstrom et al. 1995). In addition, age, sex, and length data cannot be collected using aerial index surveys.

In an effort to collect more accurate, timely, and complete escapement information than can be obtained by aerial index surveys, sonar was used to monitor summer chum salmon returns in the East Fork from 1981 to 1984 (Sandone 1989). The East Fork was chosen over the main stem because of the following: (1) sonar could be installed in the lower river because of favorable water depth and stream bottom conditions; (2) aerial index surveys prior to 1986 (Appendix 1) indicated that summer chum salmon were more abundant in the East Fork during most years; and (3) the East Fork received less recreational use than the main stem. However, the accuracy of escapement estimates was affected by large pink salmon returns in 1982 and 1984, and high water prevented proper transducer deployment in 1985 (Sandone 1989). In response to the difficulty of using sonar in the East Fork, a counting tower was used from 1986 to 1988. Favorable water conditions permitted extrapolation of summer chum, chinook, and pink salmon escapements from visual tower counts. Summer chum and chinook salmon escapements were monitored solely by aerial index surveys from 1989 to 1993 (Bergstrom et al. 1995).

Based on limited aerial index surveys, summer chum salmon returns were below desired escapement objectives throughout the Yukon River drainage from 1989 to 1993 (Bergstrom et al. 1995). Chum salmon returns to the Yukon River in 1993 were extremely poor, prompting closures of both commercial and subsistence fisheries. However, since 1988, the minimum escapement goal for the single largest producer of summer chum salmon in the Yukon River drainage, the Anvik River, has been met every year except 1990 (Bergstrom et al. 1996; D.J. Bergstrom, Alaska Department of Fish and Game, personal communication). Chum salmon escapement objectives throughout the Yukon River drainage were generally achieved from 1994 to 1996.

Summer chum salmon stocks returning to the East Fork were below the aerial index objective of 109,000 fish from 1979 to 1993 (Appendix 1). An aerial index survey conducted on July 11, 1993 under excellent survey conditions estimated only 10,935 summer chum salmon in the East Fork (Bergstrom et al. 1995). Although the survey was conducted prior to the peak of spawning, the estimate was well below the aerial index objective for the East Fork. Aerial index surveys estimating the relative abundance of summer chum salmon were not conducted during 1994, 1995, and 1996.

Chinook salmon escapement objectives were generally achieved for streams in the lower Yukon River drainage since 1992 (Bergstrom et al. 1996; D.J. Bergstrom, Alaska Department of Fish and Game, personal communication). Chinook salmon returning to the East Fork have typically exceeded the aerial index objective of 1,500 fish since 1984 (Appendix 1). The aerial index estimate was 5,855 chinook salmon in 1993. This was substantially greater than historical aerial index and tower count estimates that ranged from 274 to 2,503 fish between 1961 and 1992. Aerial index surveys of the East Fork were not completed in 1994 and 1996.

Coho, pink, and sockeye salmon abundance data are extremely limited or unavailable, and escapement objectives have not been established for these species in lower Yukon River tributaries. The status of these stocks is generally undetermined. Although no commercial fisheries are currently directed at these species, there has been a trend of increasing coho salmon harvest since 1984 (Bergstrom et al. 1996) and an interest to develop a commercial coho salmon fishery.

In compliance with ANILCA mandates, the U.S. Fish and Wildlife Service (Service) initiated a five-year study of the East Fork in 1994 to: (1) enumerate adult salmon; (2) describe run timing of chum, chinook, and pink salmon returns; (3) estimate the age, sex, and length composition of adult chum and chinook salmon populations; and (4) identify and count other fish species passing through the weir. In 1995 and 1996, weir operation was extended into September to collect abundance, run timing, and age, sex, and length composition data from returning coho salmon.

Study Area

The Andreafsky River is located in the lower Yukon River drainage in western Alaska (Figure 1). The regional climate is subarctic with extreme temperatures reaching 28.9 and -42.2°C at St. Marys, Alaska (Leslie 1989). Mean July high and February low temperatures between 1967 and 1983 were 17.6 and -18.2°C. Average yearly precipitation was approximately 48 cm of rain and 189 cm of snow. River ice breakup typically occurs in May or early June, and the river usually begins to freeze in late October (USFWS 1991). Maximum discharge is most often reached following breakup, and sporadic high discharge periods are generated by heavy rains that are prevalent between late July and early September.

Draining a watershed of 5,450 km^2, the Andreafsky River is one of the three largest Yukon River tributaries within Refuge boundaries (USFWS 1991). The main stem and its largest tributary, the East Fork, parallel each other in a southwesterly direction for over 200 river-kilometers (rkm) before converging. The main stem continues for another seven rkm before discharging into the Yukon River approximately 160 rkm from the Bering Sea. Flowing through the Andreafsky Wilderness for most of their length, the East Fork and Andreafsky River main stem are designated as wild rivers in the National Wild and Scenic River System.

The East Fork originates in the Nulato Hills at approximately 700 m elevation and drains an area of about 1,950 km^2. The river cuts through alpine tundra at an average gradient of 7.6 m per km for 48 rkm. It then flows through a forested river valley bordered by hills that rarely exceed 400 m elevation. Willow, spruce, alder, and birch dominate the riparian zone and much of the hillsides. Dropping at an average rate of 1.4 m per km, this 130-rkm long section is characterized by glides and riffles flowing over gravel and rubble substrate. The East Fork widens in the lowermost 38 rkm and meanders through a wet lowland valley interspersed with forest and tundra and bordered by hills that are typically less than 230 m elevation. A gradient of 0.14 m per km and smaller substrate particles allow an abundance of aquatic vegetation to grow in the lower stream channel. Water fluctuations in the Yukon River also have a substantial effect on the stage height in this section of the East Fork.

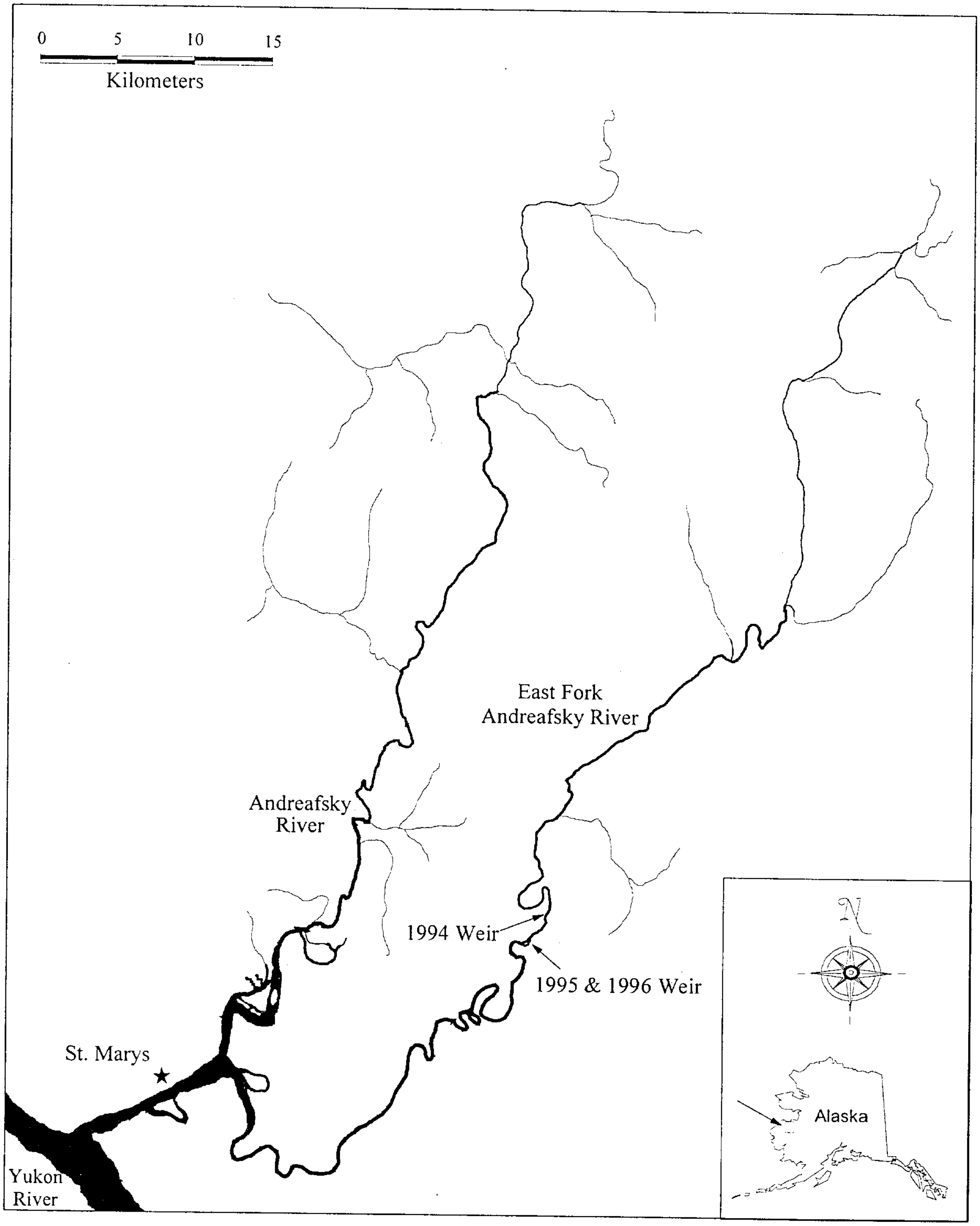

FIGURE 1.—Weir location in the East Fork Andreafsky River, Alaska, 1996.

Methods

Weir Operation

A resistance board weir (Tobin 1994; Tobin and Harper 1995) spanning 105 m was installed in the East Fork (62°07'N, 162°48'W) approximately 43 rkm upstream from the Yukon River and 26 air-km NE from St. Marys, Alaska (Figure 1). This location is approximately 2.4 rkm downstream from the 1994 weir site described by Tobin and Harper (1995) and 2.1 rkm downstream from the sonar and counting tower site described by Sandone (1989). The weir was moved downstream to this wider section of river in June 1995 to enhance its performance during high water conditions which are common in late summer.

A staff gauge was installed upstream of the weir to measure daily water levels. Staff gauge measurements were recalculated to correspond with the average water depth across the river channel at the upstream edge of the weir. Water temperatures were collected once daily between 0800 and 1100 hours.

The weir was operated from June 19 to September 16, 1996. A second live trap and passing chute was installed near mid-channel to facilitate efficient fish passage and sampling during low water periods. All fish were enumerated to species as they passed through the live traps or gaps created by partially removed pickets on fish passage panels (Tobin and Harper 1995). Salmon and resident fish that did not pass through these areas, but escaped upstream through gaps between pickets were not counted. Picket spacing was variable (3.5 and 4.8 cm), because new and recycled weir panels were used. Panels with wider picket intervals were designed to remain functional during higher flows and allow independent passage of pink salmon between pickets. Fish were passed and counted intermittently between 0001 hours and midnight each day. The duration of each counting session varied depending on the intensity of fish passage through the weir and was recorded to the nearest 0.25 h at each counting station.

The weir was inspected for holes and cleaned daily. An observer outfitted with snorkeling gear checked weir integrity and substrate conditions. Cleaning consisted of raking debris from the upstream surface of the weir or walking across each panel until it was partially submerged allowing the current to wash accumulations downstream.

Biological Data

Sample weeks or strata began on a Sunday and ended the following Saturday. However, partial weeks of weir operation shortened the length of the first and last strata. Sampling generally commenced near the middle of the week, and an effort was made to obtain a weekly quota of 160 chum, 140 chinook, and 140 coho salmon in as short a period (1-3 d) as possible to approximate a pulse or snapshot sample (Geiger et al. 1990). All target species within the trap were sampled to prevent bias.

Fish sampling consisted of measuring length, determining sex, collecting scales and then releasing the fish upstream of the weir. Length was measured from mid-eye to fork-of-caudal-fin and rounded to the nearest 5 mm. Sex was determined by observing external characteristics. Scales were removed from the preferred area for age determination (Koo 1962; Mosher 1968). One scale was collected from each chum salmon, and four scales were collected from each chinook and coho salmon. Scale impressions were made on cellulose acetate cards using a heated scale press and examined with a microfiche reader. Age was determined by a Department biologist and reported according to the European Method (Koo 1962).

Mean lengths of males and females by age were compared using a two-tailed t test at $\alpha=0.05$ (Zar 1984). Age and sex composition were estimated using a stratified sampling design (Cochran 1977). Chi-square contingency table analysis was used to test for differences in age composition between the sexes. Because the standard test only applies to data collected under simple random sampling, adjustments were made to the test statistic, following Rao and Thomas (1989), to account for the impact of our stratified sampling design on the results. The X^2 statistic, hereafter referred to as $X^2(\hat{\delta}.)$, was divided by the mean generalized design effect, $\hat{\delta}.$, as a first-order correction to the standard test (Rao and Thomas 1989). Estimated design effects for the cells and marginals are presented in the results. Age composition and associated variances for each stratum were calculated as:

$$\hat{A}_h = N_h \, p_h \; ; \tag{1}$$

$$\hat{V}\,[\hat{A}_h] = N_h^2 \left(\frac{p_h(1-p_h)}{n_h-1} \right) \; ; \tag{2}$$

where:

$\hat{A}_h$ = estimated escapement for a species of a given age and sex during stratum h;

N_h = total escapement for a species during stratum h;

p_h = proportion of the sample in stratum h of a given age and sex; and,

n_h = total number of a species in the sample for stratum h.

Abundance estimates and their variances for each stratum were summed to obtain age and sex composition estimates for combined strata as follows:

$$\hat{A}_{st} = \sum \hat{A}_h \; ; \qquad (3)$$

$$\hat{V}\,[\hat{A}_{st}] = \sum \hat{V}(\hat{A}_h) \; ; \qquad (4)$$

where:

$\hat{A}_{st}$ = estimated escapement for a species of a given age and sex for combined strata.

Results

Weir Operation

The weir was functional throughout the operational period. Low to moderate stage heights averaging 36 cm persisted throughout the operational period of the weir with minimum and maximum levels reaching 28 and 56 cm (Appendix 2). Water temperatures averaged 9.5°C from June 20 to September 16 (Appendix 2). Minimum and maximum temperatures reached 4 and 15°C.

Biological Data

Five species of Pacific salmon, including 108,450 chum, 2,955 chinook, 214,837 pink, 248 sockeye, and 8,037 coho salmon, were counted upstream through the weir (Appendix 3). Other species counted through the weir include 11 Dolly Varden *Salvelinus malma*, 3,724 whitefish *Prosopium cylindraceum* and *Coregonus* spp., and 125 northern pike *Esox lucius* (Appendix 3).

Chum salmon.—Chum salmon (N=108,450) passed through the weir from June 19 to September 16. On the first day of operation, 62 chum salmon were counted through the weir. Peak passage (N=42,501) occurred the week of June 30-July 6 (Figure 2; Appendix 3), and the median passage date was July 4 (Figure 3; Appendix 4). Counts did not exceed 110 fish per day after August 10.

Four age groups were identified from 1,277 chum salmon sampled from the weir escapement between June 19 and September 7 (Appendix 5). During this period, 108,179 chum salmon were counted through the weir. Females composed an estimated 50% of this escapement and were predominate during the month of July (Figure 3; Appendix 5). The sampled escapement was composed primarily of age 0.3 (59%) and age 0.4 (35%) chum salmon with age 0.3 fish being most abundant from June 23 to August 17 and September 1-7.

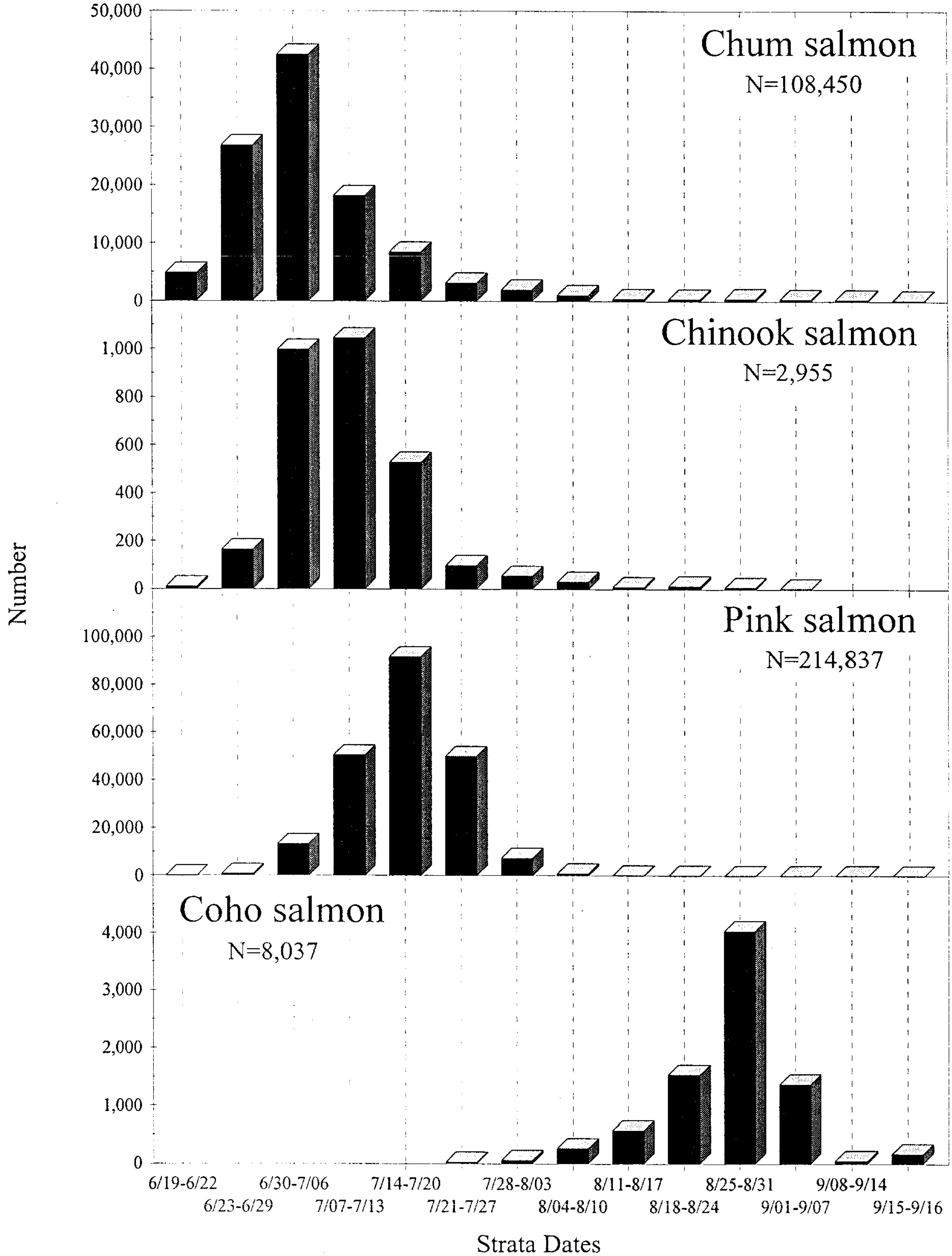

FIGURE 2.—Chum, chinook, pink, and coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1996. The first and last strata are incomplete weeks.

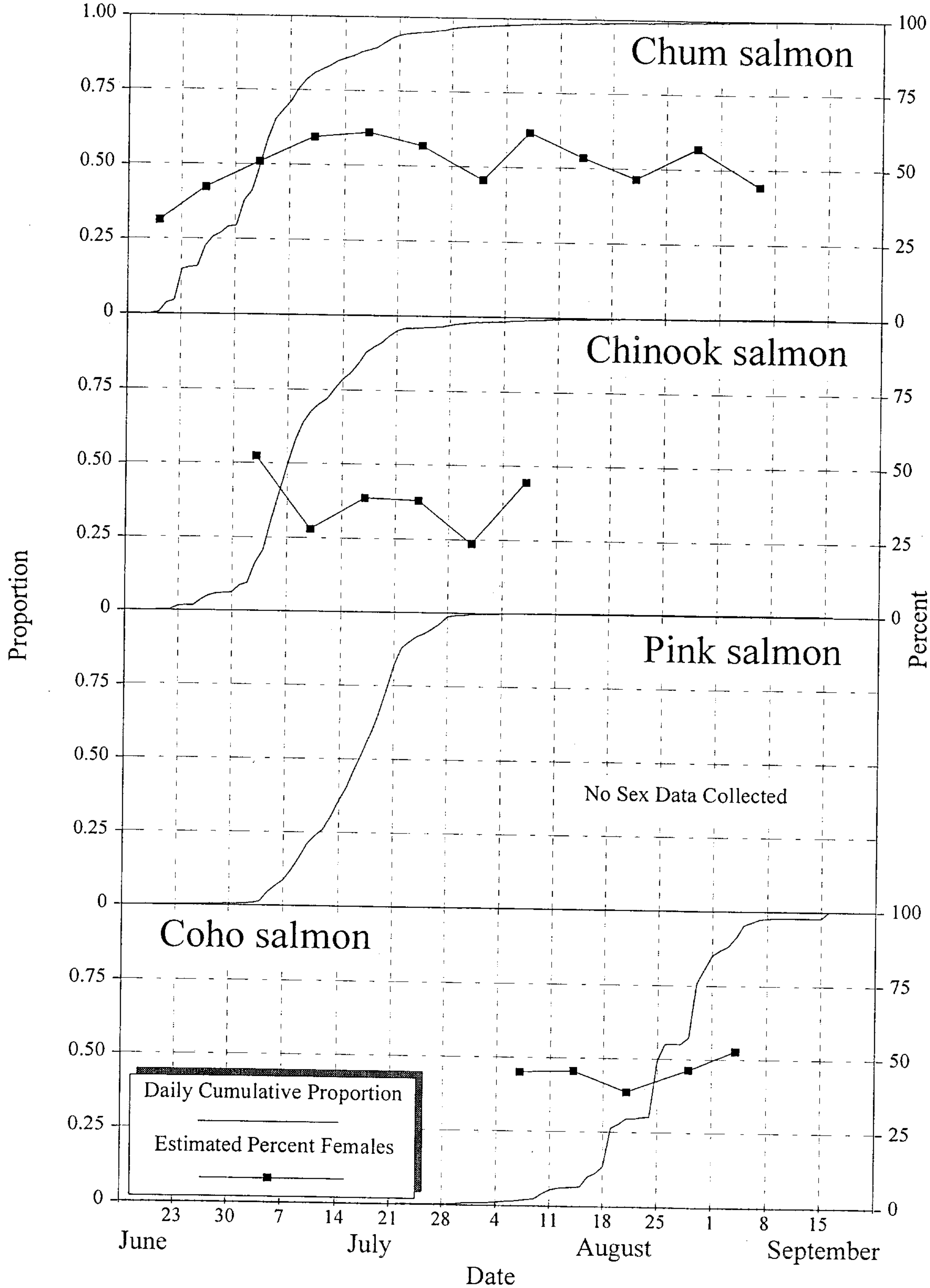

FIGURE 3.—Cumulative daily proportion and sex composition of chum, chinook, pink, and coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1996.

Age composition did not differ between sexes ($X^2(\hat{\delta})$=2.3, df=3, P=0.515). Both males and females were primarily age 0.3 (57 and 61%, respectively) followed by age 0.4 (36 and 34%, respectively). In sampled fish, the mean length of age 0.3, 0.4, and 0.5 males was greater than that of same-aged females (two-tailed t test: age 0.3, t=17.0, df=740, P<0.001; age 0.4, t=13.3, df=450, P<0.001; age 0.5, t=6.3, df=74, P<0.001)(Table 1).

TABLE 1.—Lengths at age for chum salmon sampled at the East Fork Andreafsky River weir, Alaska, 1996.

		Mid-Eye to Fork Length (mm)		
Age	N	Mean	SE	Range
		Female		
0.2	4	496	10.9	475-525
0.3	414	531	1.4	455-620
0.4	209	552	2.1	485-635
0.5	30	562	5.6	505-610
Total	657	539	1.2	455-635
		Male		
0.2	3	537	78.2	395-665
0.3	328	570	1.9	450-700
0.4	243	594	2.3	490-710
0.5	46	607	4.5	510-660
Total	620	581	1.5	395-710

Chinook salmon.—Chinook salmon (N=2,955) passed through the weir from June 21 to September 6. Peak passage (N=1,045) occurred the week of July 7-13 (Figure 2; Appendix 3), and the median passage date was July 8 (Figure 3; Appendix 4). Counts did not exceed 20 fish per day after July 22.

Six age groups were identified from 340 chinook salmon sampled from the weir escapement between June 30 and September 6 (Appendix 6). During this period, 2,780 chinook salmon were counted through the weir. Males composed an estimated 59% of this escapement (Figure 3; Appendix 6). Age 1.3 chinook salmon were most abundant (77%) followed by age 1.4 (12%) fish. Age composition differed between sexes ($X^2(\hat{\delta})$=12.7, df=4, P=0.013). Males were predominately age 1.3 (84%), and females were primarily age 1.3 (66%) followed by age 1.4 (21%). In sampled fish, the mean length of age 1.3 and 1.4 females was greater than that of same-aged males (two-tailed *t* test: age 1.3, t=2.1, df=249, P=0.036; age 1.4, t=2.9, df=44, P=0.005)(Table 2).

TABLE 2.—Lengths at age for chinook salmon sampled at the East Fork Andreafsky River weir, Alaska, 1996.

		Mid-Eye to Fork Length (mm)		
Age	N	Mean	SE	Range
		Female		
1.1	1	360	-	-
1.2	9	549	22.2	445-680
1.3	93	720	8.8	475-855
1.4	29	820	12.3	670-935
1.5	11	918	13.7	815-980
Total	143	742	9.7	360-980
		Male		
1.1	4	438	11.8	420-470
1.2	15	565	14.6	485-670
1.3	158	700	5.0	460-860
1.4	17	755	19.8	580-910
1.5	2	920	40.0	880-960
2.4	1	805	-	-
Total	197	692	6.2	420-960

Pink salmon.—Although able to pass uncounted between panel pickets, 214,837 pink salmon passed through the weir at counting stations from June 19 to September 16. Peak passage (N=91,653) occurred the week of July 14-20 (Figure 2; Appendix 3), and the median passage date was July 17 (Figure 3; Appendix 4). Counts declined to less than 100 fish per day after August 2.

Sockeye salmon.—Sockeye salmon (N=248) passed through the weir from July 2 to September 7. Peak passage (N=44) occurred the week of July 7-13 (Appendix 3), and the median passage date was July 20.

Coho salmon.—Coho salmon (N=8,037) passed through the weir from July 23 to September 19. Peak passage (N=4,036) occurred the week of August 25-31 (Figure 2; Appendix 3), and the median passage date was August 26. Counts exceeded 100 fish per day only once after September 5 (Appendix 3).

Three age groups were identified from 316 coho salmon sampled from the weir escapement between August 20 and September 9 (Appendix 7). During this period, 7,763 coho salmon were counted through the weir. Males composed an estimated 54% of this escapement and predominated through August (Figure 3; Appendix 7). Age 2.1 coho salmon were most abundant (97%). In sampled fish, the mean length of age 2.1 females was greater than that of same-aged males (two-tailed t test: t=4.3, df=306, P<0.001)(Table 3).

TABLE 3.—Lengths at age for coho salmon sampled at the East Fork Andreafsky River weir, Alaska, 1996.

		Mid-Eye to Fork Length (mm)		
Age	N	Mean	SE	Range
		Female		
1.1	4	591	11.6	560-615
2.1	140	577	2.5	430-650
Total	144	577	2.5	430-650
		Male		
1.1	3	590	40.0	510-630
2.1	168	557	3.7	435-645
3.1	1	570	-	-
Total	172	558	3.6	435-645

Discussion

Weir Operation

The weir was an effective method for counting and sampling salmon returning to the East Fork. The addition of a second trap and passing chute facilitated efficient fish passage and sampling during low water periods.

Biological Data

Picket spacing allowed pink salmon and smaller resident fish to pass upstream yet effectively blocked passage of other salmon species. Consequently, pink salmon, Dolly Varden, whitefish, and northern pike counts are conservative.

Chum salmon.—The 1996 weir escapement of 108,450 chum salmon was less than in 1994 and 1995 (N=200,981 and 172,148 respectively)(Tobin and Harper 1995; 1996). While weir counts for 1994 and 1995 exceeded all historical counts except for a 1982 sonar total of 181,352 summer chum salmon, the 1996 escapement was below average compared to historical weir, sonar, and tower counts (Appendix 1). Strong chum salmon returns to the East Fork during 1994 and 1995 corresponded with other Yukon River returns in that minimum escapement objectives were generally exceeded drainage-wide (Bergstrom et al. 1996). Although chum salmon escapement objectives were generally exceeded in the Yukon River drainage during 1996, lower river returns were not as strong as those upriver (D.J. Bergstrom, Alaska Department of Fish and Game, personal communication).

Chum salmon returned primarily as age 0.3 fish in 1994 and 1996 and age 0.4 fish in 1995. Age composition analysis revealed that fish from the 1990 brood year were most abundant in 1994 and 1995 chum salmon escapement, and 1992 brood-year fish were most abundant in the 1996. This suggests a poor return from the 1991 brood year. Except for the Anvik River, minimum escapement objectives were generally not achieved for Yukon River summer chum salmon in 1991 (Bergstrom et al. 1992).

Except for an early pulse of chum salmon in late June, 1996 run timing in the East Fork resembled that in 1994 and 1995 (Tobin and Harper 1995; 1996). In all years, migrating chum salmon were present in the river during mid-June, and peak passage occurred in early July. The weir was not operable until June 29 in 1994, but chum salmon were observed in the river prior to operation. Median passage dates during 1994, 1995, and 1996 were July 8, 5, and 4, respectively. However, the true median passage date for the 1994 East Fork chum salmon escapement would have been earlier than July 8 if uncounted fish that passed prior to weir installation are considered (Tobin and Harper 1995). Due to the early pulse of fish in 1996, approximately 25% of the chum salmon escapement passed the weir by June 27 whereas only 12% of the escapement had passed by the same date in 1995.

Chinook salmon.—The 1996 weir escapement of 2,955 chinook salmon was less than in 1994 and 1995 (N=7,801 and 5,841 respectively)(Tobin and Harper 1995; 1996). While the 1994 weir count exceeded all historical counts (Appendix 1), and the 1995 weir count was above average historical weir and tower counts (pre-1995 average=3,170 fish), the 1996 weir count was below average historical weir and tower counts (pre-1996 average=3,704 fish). Chinook salmon escapements to the East Fork during 1994 and 1995 corresponded with lower Yukon River tributaries in that minimum escapement objectives were met or exceeded (Schultz et al. 1994; Bergstrom et al. 1996). Escapements to lower Yukon River tributaries in 1996 were below average possibly as a result of harvest timing in lower district commercial fisheries (D.J. Bergstrom, Alaska Department of Fish and Game, personal communication).

Chinook salmon returned primarily as age 1.3 fish in 1994 and 1996 and age 1.4 fish in 1995. Males were predominately age 1.3 in 1994 and 1996 and age 1.2 in 1995. Females were predominately age 1.4 in 1994 and 1995 and age 1.3 in 1996. Weak 1990 brood year returns of age 1.3 fish (17%) and 1.4 fish (12%) were evident in 1995 and 1996. However, strong 1991 brood year returns of age 1.2 fish (37%) in 1995 and age 1.3 fish (77%) in 1996 indicate a potentially strong age 1.4 component in the 1997 East Fork return.

Run timing in the East Fork during 1996 resembled that in 1994 and 1995 (Tobin and Harper 1995). In all years, migrating chinook salmon were present in the river during late-June, and peak passage occurred during the second week of July. Median passage dates during 1994, 1995, and 1996 were July 11, 12, and 8, respectively. The slightly earlier median passage date in 1996 is possibly a result of early run timing or a below-average return of fish later in the run.

Pink salmon.—Pink salmon returns to the Yukon River drainage are historically strongest during even years (Bergstrom et al. 1995). The 1996 weir escapement of 214,837 pink salmon was less than in 1994 (N=316,530) and greater than in 1995 (N=1,972). These escapement totals represent only a fraction of the actual returns, because a substantial number of uncounted pink salmon pass upstream between weir pickets (Tobin and Harper 1995).

Comparison of 1996 and 1994 pink salmon escapement magnitudes should be approached with caution, because the weir was moved downstream to a wider section of river in 1995 (Tobin and Harper 1996). Weir span, picket spacing, and location of counting stations was different each year, therefore, weir counts for pink salmon are, at best, an indicator of run timing.

Timing of the 1996 pink salmon return to the East Fork resembled that in 1994 (Tobin and Harper 1995). Peak passage occurred during the third week of July for both years, and median passage dates for 1994 and 1996 were July 18 and 17, respectively. During 1995, peak passage occurred during the last week of July, and the median passage date was July 23. However, extremely low water levels during the third week of July 1995 may have delayed pink salmon migration through the weir causing counts to peak late (Tobin and Harper 1996).

Sockeye salmon.—Large populations of sockeye salmon are absent in the Yukon River drainage (Bergstrom et al. 1995), and little is known about the population in the East Fork. The magnitude of sockeye salmon escapements through the weir have been small, ranging from 33 fish in 1994 to 248 fish in 1996. Median passage dates range from July 20 in 1996 to August 16 in 1995. Run magnitude and timing results are also subject to be unreliable because of low sockeye salmon abundance and the potential for misidentification with other species.

Coho salmon.—The 1996 weir escapement of 8,037 coho salmon was less than in 1995 (N=10,901)(Tobin and Harper 1996). Historical data show two aerial index surveys of the East Fork estimating 1,657 and 1,913 coho salmon in 1981 and 1988, respectively (Appendix 1).

Age 2.1 fish were most abundant in 1995 and 1996 coho salmon escapements. However, 35% of the sampled escapement were age 1.1 in 1995, and only 3% were age 1.1 in 1996.

Run timing in the East Fork during 1996 resembled that in 1995 (Tobin and Harper 1996). During both years, peak passage occurred in late August, and median passage dates during 1995 and 1996 were August 31 and 26, respectively.

Recommendations

Based on the data in this report, the following is recommended:

1. Continue weir operation to study the result of the poor summer chum salmon returns during 1993. The majority of 1993 brood-year fish should return as age 0.3 and 0.4 fish during 1997 and 1998.

2. Continue weir operation into late September to obtain comprehensive escapement data for coho salmon returns.

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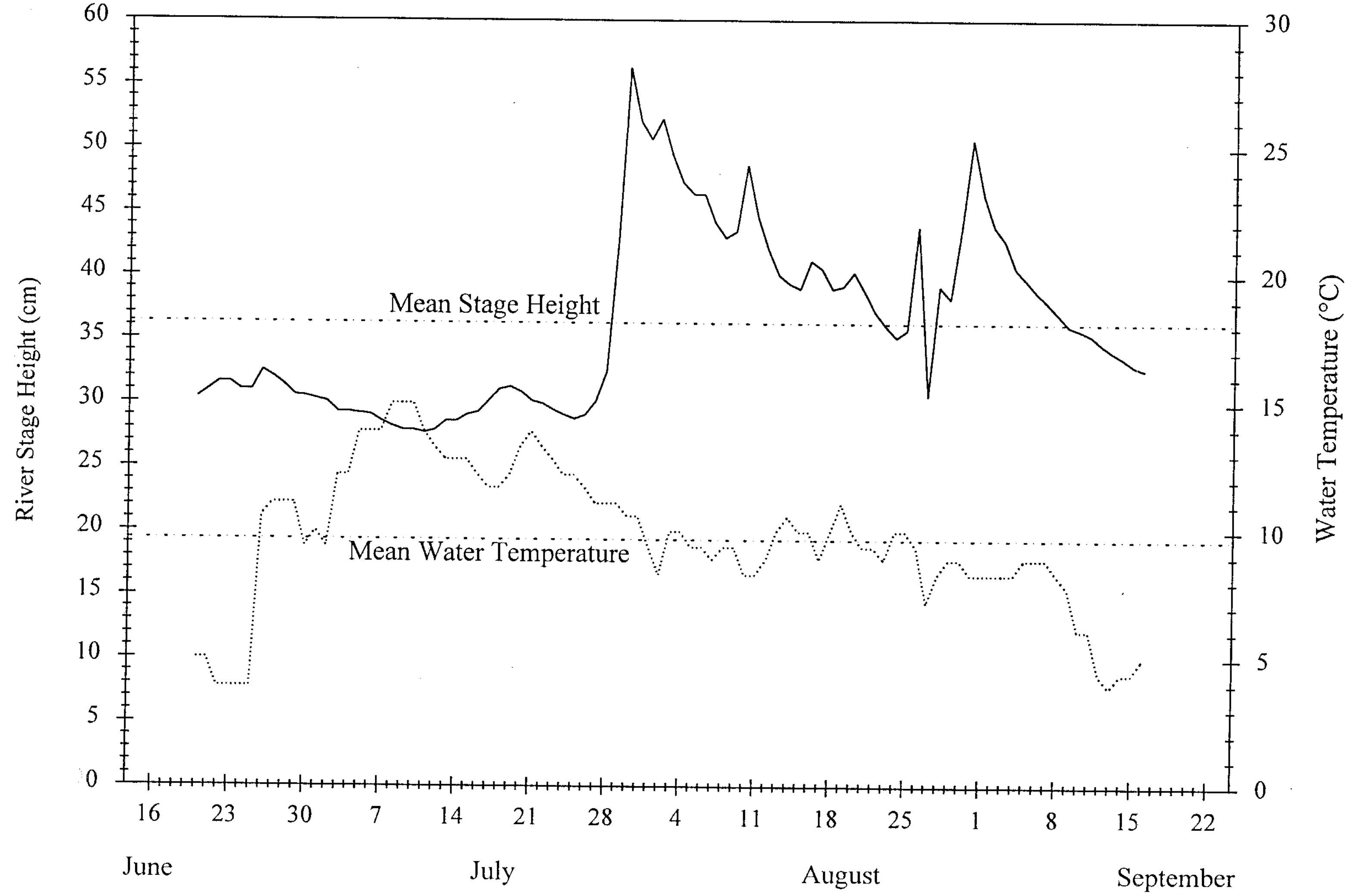
Appendix 1.-Chum, chinook, and coho salmon escapement counts for the Andreafsky River, Alaska, 1961-1996. All data, except weir counts and 1996 aerial index survey estimate, are from Bergstrom et al. (1996).

	East Fork Andreafsky River						Main Stem Andreafsky River		
	Aerial Index Surveys			Sonar, Tower, or Weir			Aerial Index Surveys		
Year	Chinook Salmon	Chum Salmon	Coho Salmon	Chinook Salmon	Chum Salmon	Coho Salmon	Chinook Salmon	Chum Salmon	Coho Salmon
1961	1,003								
1962	675 [a]						762 [a]		
1963									
1964	867						705		
1965							344 [a]		
1966	361						303		
1967							276 [a]		
1968	380						383		
1969	274 [a]						231 [a]		
1970	665						574 [a]		
1971	1,904						1,682		
1972	798						582 [a]		
1973	825	10,149 [a]					788	51,835	
1974		3,215 [a]					285	33,578	
1975	993	223,485					301	235,954	
1976	818	105,347					643	118,420	
1977	2,008	112,722					1,499	63,120	
1978	2,487	127,050					1,062	57,321	
1979	1,180	66,471					1,134	43,391	
1980	958 [a]	36,823 [a]					1,500	114,759	
1981	2,146 [a]	81,555	1,657 [a]		147,312 [b]		231 [a]		
1982	1,274	7,501 [a]			181,352 [b]		851	7,267 [a]	
1983					110,608 [b]				
1984	1,573 [a]	95,200 [a]			70,125 [b]		1,993	238,565	
1985	1,617	66,146					2,248	52,750	
1986	1,954	83,931		1,530 [c]	167,614 [c]		3,158	99,373	
1987	1,608	6,687 [a]		2,011 [c]	45,221 [c]		3,281	35,535	
1988	1,020	43,056	1,913	1,339 [c]	68,937 [c]		1,448	45,432	830
1989	1,399	21,460 [a]					1,089		
1990	2,503	11,519 [a]					1,545	20,426 [a]	
1991	1,938	31,886					2,544	46,657	
1992	1,030 [a]	11,308 [a]					2,002 [a]	37,808 [a]	
1993	5,855	10,935 [a]					2,765	9,111 [a]	
1994	300 [a]			7,801 [d]	200,981 [ad]		213 [a]		
1995	1,635			5,841 [d]	172,148 [d]	10,901 [d]	1,108		
1996				2,955 [d]	108,450 [d]	8,037 [d]	624 [e]		
I.O.	>1,500	>109,000					>1,400	>116,000	

I.O. Interim aerial index objective
[a] *Incomplete survey and/or poor survey timing or conditions resulting in minimal or inaccurate count*
[b] *Sonar count*
[c] *Tower count*
[d] *Weir count*
[e] *Preliminary data from D.J. Bergstrom, Alaska Department of Fish and Game, personal communication*



Appendix 2.-River stage heights and water temperatures at the East Fork Andreafsky River weir, Alaska, 1996.

Appendix 3.-Daily escapement and counting effort at the East Fork Andreafsky River weir, Alaska, 1996.

Date	Counting Effort (h)	Chum Salmon	Chinook Salmon	Pink Salmon	Sockeye Salmon	Coho Salmon	Dolly Varden	Whitefish	Northern Pike
				Stratum 1					
06/19	7.25	62	0	12	0	0	0	41	0
06/20	8.00	424	0	4	0	0	0	41	1
06/21	10.75	3,315	10	40	0	0	0	31	3
06/22	9.00	1,036	0	42	0	0	0	28	5
Total:	35.00	4,837	10	98	0	0	0	141	9
				Stratum 2					
06/23	14.00	11,195	33	157	0	0	0	77	4
06/24	10.25	798	6	67	0	0	0	37	2
06/25	9.75	303	0	24	0	0	0	36	1
06/26	12.00	7,306	59	153	0	0	0	44	1
06/27	13.50	3,435	42	218	0	0	0	62	2
06/28	12.25	1,463	19	80	0	0	0	37	3
06/29	12.50	2,335	6	78	0	0	0	26	2
Total:	84.25	26,835	165	777	0	0	0	319	15
				Stratum 3					
06/30	12.00	314	8	41	0	0	0	11	1
07/01	13.25	9,164	72	184	0	0	0	12	0
07/02	11.25	3,326	21	107	6	0	0	16	1
07/03	14.25	8,973	205	347	9	0	0	38	1
07/04	14.00	10,018	124	1,254	16	0	1	74	1
07/05	15.75	7,355	309	6,678	6	0	0	97	3
07/06	13.25	3,351	258	4,676	1	0	0	90	2
Total:	93.75	42,501	997	13,287	38	0	1	338	9
				Stratum 4					
07/07	12.50	3,124	280	3,834	7	0	0	104	5
07/08	14.50	4,771	244	7,472	0	0	0	44	3
07/09	11.25	3,500	186	8,905	10	0	0	42	1
07/10	13.75	2,303	111	10,290	6	0	0	35	6
07/11	10.50	1,275	72	5,822	6	0	0	40	14
07/12	8.25	1,497	52	4,662	8	0	0	50	10
07/13	12.00	1,680	100	9,484	7	0	0	36	4
Total:	82.75	18,150	1,045	50,469	44	0	0	351	43
				Stratum 5					
07/14	12.25	1,038	96	11,760	9	0	0	56	8
07/15	11.25	935	62	9,754	4	0	0	58	6
07/16	12.00	1,280	95	13,476	5	0	0	33	2
07/17	14.50	774	110	12,222	4	0	0	63	7
07/18	12.50	852	55	12,682	8	0	0	33	0
07/19	13.50	1,848	42	14,282	7	0	0	84	2
07/20	10.50	1,721	69	17,477	6	0	0	118	6
Total:	86.50	8,448	529	91,653	43	0	0	445	31

(Continued)

Appendix 3.-(Continued).

Date	Counting Effort (h)	Chum Salmon	Chinook Salmon	Pink Salmon	Sockeye Salmon	Coho Salmon	Dolly Varden	Whitefish	Northern Pike
				Stratum 6					
07/21	13.50	1,116	51	18,780	3	0	0	89	7
07/22	13.75	605	26	13,018	4	0	0	51	4
07/23	13.75	246	2	4,744	4	11	0	30	4
07/24	11.50	291	4	3,778	1	2	0	9	1
07/25	8.00	196	6	2,473	1	1	0	7	0
07/26	7.25	365	3	3,365	3	4	0	28	0
07/27	11.00	278	6	3,768	3	0	0	29	1
Total:	78.75	3,097	98	49,926	19	18	0	243	17
				Stratum 7					
07/28	11.50	738	16	5,036	2	3	0	31	0
07/29	10.75	334	13	1,035	0	3	0	6	0
07/30	7.75	272	7	205	0	9	0	9	1
07/31	10.25	260	10	706	5	25	0	24	0
08/01	8.75	93	4	169	1	1	0	0	0
08/02	10.00	158	2	107	1	7	0	4	0
08/03	4.00	91	2	127	1	4	0	5	0
Total:	63.00	1,946	54	7,385	10	52	0	79	1
				Stratum 8					
08/04	6.25	192	5	300	4	15	0	2	0
08/05	8.00	132	6	237	1	20	0	3	0
08/06	4.50	215	2	61	4	10	0	2	0
08/07	6.00	163	7	109	3	26	0	9	0
08/08	9.00	54	3	61	1	20	0	15	0
08/09	6.00	110	2	55	5	26	0	7	0
08/10	6.00	137	5	77	3	138	0	16	0
Total:	45.75	1,003	30	900	21	255	0	54	0
				Stratum 9					
08/11	6.75	63	2	44	2	105	0	33	0
08/12	5.75	65	3	51	0	50	0	50	0
08/13	4.25	26	0	25	0	16	0	66	0
08/14	7.00	35	0	16	1	11	0	40	0
08/15	7.75	59	0	7	1	19	0	46	0
08/16	7.25	80	3	25	5	276	0	56	0
08/17	4.74	35	0	8	0	92	0	20	0
Total:	43.49	363	8	176	9	569	0	311	0
				Stratum 10					
08/18	4.50	33	2	17	1	179	0	44	0
08/19	7.00	110	2	40	5	1,052	1	111	0
08/20	10.50	33	3	4	1	100	0	24	0
08/21	10.25	64	3	2	3	149	2	75	0
08/22	11.00	27	0	3	1	9	1	28	0
08/23	5.50	37	2	8	0	32	0	42	0
08/24	3.75	26	0	7	3	12	0	21	0
Total:	52.50	330	12	81	14	1,533	4	345	0

(Continued)

Appendix 3.-(Continued).

Date	Counting Effort (h)	Chum Salmon	Chinook Salmon	Pink Salmon	Sockeye Salmon	Coho Salmon	Dolly Varden	Whitefish	Northern Pike
				Stratum 11					
08/25	7.25	103	0	16	16	1,539	0	30	0
08/26	6.50	35	1	28	6	449	0	110	0
08/27	12.00	26	0	1	2	5	0	60	0
08/28	9.00	39	0	1	2	1	0	13	0
08/29	6.25	78	2	1	4	179	0	26	0
08/30	5.25	66	1	6	5	1,489	0	47	0
08/31	6.75	31	2	4	0	374	1	62	0
Total:	53.00	378	6	57	35	4,036	1	348	0
				Stratum 12					
09/01	6.25	38	0	7	2	374	0	58	0
09/02	6.75	40	0	4	1	147	2	63	0
09/03	7.00	49	0	7	3	100	2	63	0
09/04	6.00	48	0	1	3	250	0	37	0
09/05	7.50	37	0	3	3	337	0	26	0
09/06	12.75	29	1	0	2	78	1	32	0
09/07	5.50	50	0	1	1	84	0	84	0
Total:	51.75	291	1	23	15	1,370	5	363	0
				Stratum 13					
09/08	7.00	39	0	0	0	24	0	42	0
09/09	7.25	32	0	1	0	16	0	48	0
09/10	7.75	32	0	0	0	1	0	32	0
09/11	4.75	24	0	0	0	0	0	35	0
09/12	5.25	16	0	0	0	0	0	31	0
09/13	5.00	18	0	3	0	0	0	39	0
09/14	5.25	39	0	0	0	0	0	49	0
Total:	42.25	200	0	4	0	41	0	276	0
				Stratum 14					
09/15	3.75	33	0	0	0	3	0	84	0
09/16	2.00	38	0	1	0	160	0	27	0
Total:	5.75	71	0	1	0	163	0	111	0
				All Strata					
Total:	818.49	108,450	2,955	214,837	248	8,037	11	3,724	125

Appendix 4.-Daily, cumulative, and cumulative proportion of chum, chinook, pink, and coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1996.

	Chum Salmon			Chinook Salmon			Pink Salmon			Coho Salmon		
Date	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion
06/19	62	62	0.001	0	0	0.000	12	12	0.000	0	0	0.000
06/20	424	486	0.004	0	0	0.000	4	16	0.000	0	0	0.000
06/21	3,315	3,801	0.035	10	10	0.003	40	56	0.000	0	0	0.000
06/22	1,036	4,837	0.045	0	10	0.003	42	98	0.000	0	0	0.000
06/23	11,195	16,032	0.148	33	43	0.015	157	255	0.001	0	0	0.000
06/24	798	16,830	0.155	6	49	0.017	67	322	0.001	0	0	0.000
06/25	303	17,133	0.158	0	49	0.017	24	346	0.002	0	0	0.000
06/26	7,306	24,439	0.225	59	108	0.037	153	499	0.002	0	0	0.000
06/27	3,435	27,874	0.257	42	150	0.051	218	717	0.003	0	0	0.000
06/28	1,463	29,337	0.271	19	169	0.057	80	797	0.004	0	0	0.000
06/29	2,335	31,672	0.292	6	175	0.059	78	875	0.004	0	0	0.000
06/30	314	31,986	0.295	8	183	0.062	41	916	0.004	0	0	0.000
07/01	9,164	41,150	0.379	72	255	0.086	184	1,100	0.005	0	0	0.000
07/02	3,326	44,476	0.410	21	276	0.093	107	1,207	0.006	0	0	0.000
07/03	8,973	53,449	0.493	205	481	0.163	347	1,554	0.007	0	0	0.000
07/04	10,018	63,467	0.585	124	605	0.205	1,254	2,808	0.013	0	0	0.000
07/05	7,355	70,822	0.653	309	914	0.309	6,678	9,486	0.044	0	0	0.000
07/06	3,351	74,173	0.684	258	1,172	0.397	4,676	14,162	0.066	0	0	0.000
07/07	3,124	77,297	0.713	280	1,452	0.491	3,834	17,996	0.084	0	0	0.000
07/08	4,771	82,068	0.757	244	1,696	0.574	7,472	25,468	0.119	0	0	0.000
07/09	3,500	85,568	0.789	186	1,882	0.637	8,905	34,373	0.160	0	0	0.000
07/10	2,303	87,871	0.810	111	1,993	0.674	10,290	44,663	0.208	0	0	0.000
07/11	1,275	89,146	0.822	72	2,065	0.699	5,822	50,485	0.235	0	0	0.000
07/12	1,497	90,643	0.836	52	2,117	0.716	4,662	55,147	0.257	0	0	0.000
07/13	1,680	92,323	0.851	100	2,217	0.750	9,484	64,631	0.301	0	0	0.000

(Continued)

Appendix 4.-(Continued).

	Chum Salmon			Chinook Salmon			Pink Salmon			Coho Salmon		
Date	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion
07/14	1,038	93,361	0.861	96	2,313	0.783	11,760	76,391	0.356	0	0	0.000
07/15	935	94,296	0.869	62	2,375	0.804	9,754	86,145	0.401	0	0	0.000
07/16	1,280	95,576	0.881	95	2,470	0.836	13,476	99,621	0.464	0	0	0.000
07/17	774	96,350	0.888	110	2,580	0.873	12,222	111,843	0.521	0	0	0.000
07/18	852	97,202	0.896	55	2,635	0.892	12,682	124,525	0.580	0	0	0.000
07/19	1,848	99,050	0.913	42	2,677	0.906	14,282	138,807	0.646	0	0	0.000
07/20	1,721	100,771	0.929	69	2,746	0.929	17,477	156,284	0.727	0	0	0.000
07/21	1,116	101,887	0.939	51	2,797	0.947	18,780	175,064	0.815	0	0	0.000
07/22	605	102,492	0.945	26	2,823	0.955	13,018	188,082	0.875	0	0	0.000
07/23	246	102,738	0.947	2	2,825	0.956	4,744	192,826	0.898	11	11	0.001
07/24	291	103,029	0.950	4	2,829	0.957	3,778	196,604	0.915	2	13	0.002
07/25	196	103,225	0.952	6	2,835	0.959	2,473	199,077	0.927	1	14	0.002
07/26	365	103,590	0.955	3	2,838	0.960	3,365	202,442	0.942	4	18	0.002
07/27	278	103,868	0.958	6	2,844	0.962	3,768	206,210	0.960	0	18	0.002
07/28	738	104,606	0.965	16	2,860	0.968	5,036	211,246	0.983	3	21	0.003
07/29	334	104,940	0.968	13	2,873	0.972	1,035	212,281	0.988	3	24	0.003
07/30	272	105,212	0.970	7	2,880	0.975	205	212,486	0.989	9	33	0.004
07/31	260	105,472	0.973	10	2,890	0.978	706	213,192	0.992	25	58	0.007
08/01	93	105,565	0.973	4	2,894	0.979	169	213,361	0.993	1	59	0.007
08/02	158	105,723	0.975	2	2,896	0.980	107	213,468	0.994	7	66	0.008
08/03	91	105,814	0.976	2	2,898	0.981	127	213,595	0.994	4	70	0.009
08/04	192	106,006	0.977	5	2,903	0.982	300	213,895	0.996	15	85	0.011
08/05	132	106,138	0.979	6	2,909	0.984	237	214,132	0.997	20	105	0.013
08/06	215	106,353	0.981	2	2,911	0.985	61	214,193	0.997	10	115	0.014
08/07	163	106,516	0.982	7	2,918	0.987	109	214,302	0.998	26	141	0.018
08/08	54	106,570	0.983	3	2,921	0.988	61	214,363	0.998	20	161	0.020

(Continued)

Appendix 4.-(Continued).

Date	Chum Salmon Daily Count	Chum Salmon Cumulative Count	Chum Salmon Cumulative Proportion	Chinook Salmon Daily Count	Chinook Salmon Cumulative Count	Chinook Salmon Cumulative Proportion	Pink Salmon Daily Count	Pink Salmon Cumulative Count	Pink Salmon Cumulative Proportion	Coho Salmon Daily Count	Coho Salmon Cumulative Count	Coho Salmon Cumulative Proportion
08/09	110	106,680	0.984	2	2,923	0.989	55	214,418	0.998	26	187	0.023
08/10	137	106,817	0.985	5	2,928	0.991	77	214,495	0.998	138	325	0.040
08/11	63	106,880	0.986	2	2,930	0.992	44	214,539	0.999	105	430	0.054
08/12	65	106,945	0.986	3	2,933	0.993	51	214,590	0.999	50	480	0.060
08/13	26	106,971	0.986	0	2,933	0.993	25	214,615	0.999	16	496	0.062
08/14	35	107,006	0.987	0	2,933	0.993	16	214,631	0.999	11	507	0.063
08/15	59	107,065	0.987	0	2,933	0.993	7	214,638	0.999	19	526	0.065
08/16	80	107,145	0.988	3	2,936	0.994	25	214,663	0.999	276	802	0.100
08/17	35	107,180	0.988	0	2,936	0.994	8	214,671	0.999	92	894	0.111
08/18	33	107,213	0.989	2	2,938	0.994	17	214,688	0.999	179	1,073	0.134
08/19	110	107,323	0.990	2	2,940	0.995	40	214,728	0.999	1,052	2,125	0.264
08/20	33	107,356	0.990	3	2,943	0.996	4	214,732	1.000	100	2,225	0.277
08/21	64	107,420	0.991	3	2,946	0.997	2	214,734	1.000	149	2,374	0.295
08/22	27	107,447	0.991	0	2,946	0.997	3	214,737	1.000	9	2,383	0.297
08/23	37	107,484	0.991	2	2,948	0.998	8	214,745	1.000	32	2,415	0.300
08/24	26	107,510	0.991	0	2,948	0.998	7	214,752	1.000	12	2,427	0.302
08/25	103	107,613	0.992	0	2,948	0.998	16	214,768	1.000	1,539	3,966	0.493
08/26	35	107,648	0.993	1	2,949	0.998	28	214,796	1.000	449	4,415	0.549
08/27	26	107,674	0.993	0	2,949	0.998	1	214,797	1.000	5	4,420	0.550
08/28	39	107,713	0.993	0	2,949	0.998	1	214,798	1.000	1	4,421	0.550
08/29	78	107,791	0.994	2	2,951	0.999	1	214,799	1.000	179	4,600	0.572
08/30	66	107,857	0.995	1	2,952	0.999	6	214,805	1.000	1,489	6,089	0.758
08/31	31	107,888	0.995	2	2,954	1.000	4	214,809	1.000	374	6,463	0.804
09/01	38	107,926	0.995	0	2,954	1.000	7	214,816	1.000	374	6,837	0.851
09/02	40	107,966	0.996	0	2,954	1.000	4	214,820	1.000	147	6,984	0.869
09/03	49	108,015	0.996	0	2,954	1.000	7	214,827	1.000	100	7,084	0.881

(Continued)

Appendix 4.-(Continued).

	Chum Salmon			Chinook Salmon			Pink Salmon			Coho Salmon		
Date	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion	Daily Count	Cumulative Count	Cumulative Proportion
09/04	48	108,063	0.996	0	2,954	1.000	1	214,828	1.000	250	7,334	0.913
09/05	37	108,100	0.997	0	2,954	1.000	3	214,831	1.000	337	7,671	0.954
09/06	29	108,129	0.997	1	2,955	1.000	0	214,831	1.000	78	7,749	0.964
09/07	50	108,179	0.998	0	2,955	1.000	1	214,832	1.000	84	7,833	0.975
09/08	39	108,218	0.998	0	2,955	1.000	0	214,832	1.000	24	7,857	0.978
09/09	32	108,250	0.998	0	2,955	1.000	1	214,833	1.000	16	7,873	0.980
09/10	32	108,282	0.998	0	2,955	1.000	0	214,833	1.000	1	7,874	0.980
09/11	24	108,306	0.999	0	2,955	1.000	0	214,833	1.000	0	7,874	0.980
09/12	16	108,322	0.999	0	2,955	1.000	0	214,833	1.000	0	7,874	0.980
09/13	18	108,340	0.999	0	2,955	1.000	3	214,836	1.000	0	7,874	0.980
09/14	39	108,379	0.999	0	2,955	1.000	0	214,836	1.000	0	7,874	0.980
09/15	33	108,412	1.000	0	2,955	1.000	0	214,836	1.000	3	7,877	0.980
09/16	38	108,450	1.000	0	2,955	1.000	1	214,837	1.000	160	8,037	1.000

Appendix 5.-Estimated age and sex composition of weekly chum salmon escapement through the East Fork Andreafsky River weir, Alaska, 1996, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group				
		1993	1992	1991	1990	
		0.2	0.3	0.4	0.5	Total
Stratum 1: 6/19 - 6/22 Sampling Dates: 6/20 & 6/21						
Female:	Number in Sample:	0	13	25	9	47
	Estimated % of Escapement:	0.0	8.7	16.7	6.0	31.3
	Estimated Escapement:	0	419	806	290	1,516
Male:	Number in Sample:	0	25	58	20	103
	Estimated % of Escapement:	0.0	16.7	38.7	13.3	68.7
	Estimated Escapement:	0	806	1,870	645	3,321
Total:	Number in Sample:	0	38	83	29	150
	Estimated % of Escapement:	0.0	25.3	55.3	19.3	100.0
	Estimated Escapement:	0	1,225	2,676	935	4,837
	Standard Error:	0	172	197	156	
Stratum 2: 6/23 - 6/29 Sampling Dates: 6/23 & 6/26						
Female:	Number in Sample:	0	26	28	5	59
	Estimated % of Escapement:	0.0	18.7	20.1	3.6	42.4
	Estimated Escapement:	0	5,019	5,406	965	11,390
Male:	Number in Sample:	0	37	33	10	80
	Estimated % of Escapement:	0.0	26.6	23.7	7.2	57.6
	Estimated Escapement:	0	7,143	6,371	1,931	15,445
Total:	Number in Sample:	0	63	61	15	139
	Estimated % of Escapement:	0.0	45.3	43.9	10.8	100.0
	Estimated Escapement:	0	12,163	11,777	2,896	26,835
	Standard Error:	0	1,137	1,134	709	
Stratum 3: 6/30 - 7/06 Sampling Dates: 7/01 - 7/03						
Female:	Number in Sample:	0	42	26	4	72
	Estimated % of Escapement:	0.0	29.8	18.4	2.8	51.1
	Estimated Escapement:	0	12,660	7,837	1,206	21,703
Male:	Number in Sample:	1	40	25	3	69
	Estimated % of Escapement:	0.7	28.4	17.7	2.1	48.9
	Estimated Escapement:	301	12,057	7,536	904	20,798
Total:	Number in Sample:	1	82	51	7	141
	Estimated % of Escapement:	0.7	58.2	36.2	5.0	100.0
	Estimated Escapement:	301	24,717	15,373	2,110	42,501
	Standard Error:	301	1,772	1,726	780	

(Continued)

Appendix 5.-(Continued).

		Brood Year and Age Group				
		1993	1992	1991	1990	
		0.2	0.3	0.4	0.5	Total
Stratum 4: 7/07 - 7/13 Sampling Dates: 7/09 & 7/10						
Female:	Number in Sample:	2	63	22	1	88
	Estimated % of Escapement:	1.4	42.6	14.9	0.7	59.5
	Estimated Escapement:	245	7,726	2,698	123	10,792
Male:	Number in Sample:	0	40	17	3	60
	Estimated % of Escapement:	0.0	27.0	11.5	2.0	40.5
	Estimated Escapement:	0	4,905	2,085	368	7,358
Total:	Number in Sample:	2	103	39	4	148
	Estimated % of Escapement:	1.4	69.6	26.4	2.7	100.0
	Estimated Escapement:	245	12,631	4,783	491	18,150
	Standard Error:	173	689	659	243	
Stratum 5: 7/14 - 7/20 Sampling Dates: 7/16 & 7/17						
Female:	Number in Sample:	0	64	19	2	85
	Estimated % of Escapement:	0.0	46.0	13.7	1.4	61.2
	Estimated Escapement:	0	3,890	1,155	122	5,166
Male:	Number in Sample:	0	37	14	3	54
	Estimated % of Escapement:	0.0	26.6	10.1	2.2	38.8
	Estimated Escapement:	0	2,249	851	182	3,282
Total:	Number in Sample:	0	101	33	5	139
	Estimated % of Escapement:	0.0	72.7	23.7	3.6	100.0
	Estimated Escapement:	0	6,138	2,006	304	8,448
	Standard Error:	0	321	306	134	
Stratum 6: 7/21 - 7/27 Sampling Dates: 7/23 - 7/25						
Female:	Number in Sample:	1	65	17	2	85
	Estimated % of Escapement:	0.7	43.6	11.4	1.3	57.0
	Estimated Escapement:	21	1,351	353	42	1,767
Male:	Number in Sample:	1	43	19	1	64
	Estimated % of Escapement:	0.7	28.9	12.8	0.7	43.0
	Estimated Escapement:	21	894	395	21	1,330
Total:	Number in Sample:	2	108	36	3	149
	Estimated % of Escapement:	1.3	72.5	24.2	2.0	100.0
	Estimated Escapement:	42	2,245	748	62	3,097
	Standard Error:	29	114	109	36	

(Continued)

Appendix 5.-(Continued).

		Brood Year and Age Group				
		1993	1992	1991	1990	
		0.2	0.3	0.4	0.5	Total
Stratum 7: 7/28 - 8/03 Sampling Dates: 8/01 - 8/03						
Female:	Number in Sample:	0	36	12	1	49
	Estimated % of Escapement:	0.0	33.6	11.2	0.9	45.8
	Estimated Escapement:	0	655	218	18	891
Male:	Number in Sample:	0	37	20	1	58
	Estimated % of Escapement:	0.0	34.6	18.7	0.9	54.2
	Estimated Escapement:	0	673	364	18	1,055
Total:	Number in Sample:	0	73	32	2	107
	Estimated % of Escapement:	0.0	68.2	29.9	1.9	100.0
	Estimated Escapement:	0	1,328	582	36	1,946
	Standard Error:	0	88	87	26	
Stratum 8: 8/04 - 8/10 Sampling Dates: 8/06 & 8/07						
Female:	Number in Sample:	1	61	30	2	94
	Estimated % of Escapement:	0.7	40.1	19.7	1.3	61.8
	Estimated Escapement:	7	403	198	13	620
Male:	Number in Sample:	0	37	21	0	58
	Estimated % of Escapement:	0.0	24.3	13.8	0.0	38.2
	Estimated Escapement:	0	244	139	0	383
Total:	Number in Sample:	1	98	51	2	152
	Estimated % of Escapement:	0.7	64.5	33.6	1.3	100.0
	Estimated Escapement:	7	647	337	13	1,003
	Standard Error:	7	39	39	9	
Stratum 9: 8/11 - 8/17 Sampling Dates: 8/14 & 8/15						
Female:	Number in Sample:	0	13	8	1	22
	Estimated % of Escapement:	0.0	31.7	19.5	2.4	53.7
	Estimated Escapement:	0	115	71	9	195
Male:	Number in Sample:	0	12	7	0	19
	Estimated % of Escapement:	0.0	29.3	17.1	0.0	46.3
	Estimated Escapement:	0	106	62	0	168
Total:	Number in Sample:	0	25	15	1	41
	Estimated % of Escapement:	0.0	61.0	36.6	2.4	100.0
	Estimated Escapement:	0	221	133	9	363
	Standard Error:	0	28	28	9	

(Continued)

Appendix 5.-(Continued).

		Brood Year and Age Group				
		1993	1992	1991	1990	
		0.2	0.3	0.4	0.5	Total
Stratum 10: 8/18 - 8/24 Sampling Dates: 8/20 - 8/22						
Female:	Number in Sample:	0	18	10	0	28
	Estimated % of Escapement:	0.0	30.0	16.7	0.0	46.7
	Estimated Escapement:	0	99	55	0	154
Male:	Number in Sample:	0	11	20	1	32
	Estimated % of Escapement:	0.0	18.3	33.3	1.7	53.3
	Estimated Escapement:	0	61	110	6	176
Total:	Number in Sample:	0	29	30	1	60
	Estimated % of Escapement:	0.0	48.3	50.0	1.7	100.0
	Estimated Escapement:	0	160	165	6	330
	Standard Error:	0	21	21	6	
Stratum 11: 8/25 - 8/31 Sampling Dates: 8/29 - 8/31						
Female:	Number in Sample:	0	9	12	3	24
	Estimated % of Escapement:	0.0	21.4	28.6	7.1	57.1
	Estimated Escapement:	0	81	108	27	216
Male:	Number in Sample:	1	7	7	3	18
	Estimated % of Escapement:	2.4	16.7	16.7	7.1	42.9
	Estimated Escapement:	9	63	63	27	162
Total:	Number in Sample:	1	16	19	6	42
	Estimated % of Escapement:	2.4	38.1	45.2	14.3	100.0
	Estimated Escapement:	9	144	171	54	378
	Standard Error:	9	29	29	21	
Stratum 12: 9/01 - 9/07 Sampling Date: 9/06						
Female:	Number in Sample:	0	4	0	0	4
	Estimated % of Escapement:	0.0	44.4	0.0	0.0	44.4
	Estimated Escapement:	0	129	0	0	129
Male:	Number in Sample:	0	2	2	1	5
	Estimated % of Escapement:	0.0	22.2	22.2	11.1	55.6
	Estimated Escapement:	0	65	65	32	162
Total:	Number in Sample:	0	6	2	1	9
	Estimated % of Escapement:	0.0	66.7	22.2	11.1	100.0
	Estimated Escapement:	0	194	65	32	291
	Standard Error:	0	49	43	32	
Strata 13 & 14: 9/08 - 9/16 No samples collected						

(Continued)

Appendix 5.-(Continued).

		Brood Year and Age Group				
		1993	1992	1991	1990	
		0.2	0.3	0.4	0.5	Total
Strata 1 - 12 Combined: 6/19 - 9/07 Sampling Dates: 6/20 - 9/06						
Female:	Number in Sample:	4	414	209	30	657
	% Females in Age Group:	0.5	59.7	34.7	5.2	100.0
	Estimated % of Escapement:	0.3	30.1	17.5	2.6	50.4
	Estimated Escapement:	273	32,547	18,905	2,814	54,539
	Estimated Design Effects:	1.316	2.183	2.388	2.450	2.280
Male:	Number in Sample:	3	328	243	46	620
	% Males in Age Group:	0.6	54.6	37.1	7.7	100.0
	Estimated % of Escapement:	0.3	27.1	18.4	3.8	49.6
	Estimated Escapement:	331	29,266	19,909	4,134	53,640
	Estimated Design Effects:	3.264	2.338	2.291	2.055	2.280
Total:	Number in Sample:	7	742	452	76	1,277
	Estimated % of Escapement:	0.6	57.1	35.9	6.4	100.0
	Estimated Escapement:	604	61,813	38,814	6,948	108,179 *
	Standard Error:	349	2,251	2,204	1,103	
	Estimated Design Effects:	2.391	2.256	2.301	2.206	

*271 fish that were counted through the weir during strata 13 and 14 are not included in this total.

Appendix 6.-Estimated age and sex composition of weekly chinook salmon escapement through the East Fork Andreafsky River weir, Alaska, 1996, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group						
		1993	1992	1991	1990	1989		
		1.1	1.2	1.3	1.4	1.5	2.4	Total
Strata 1 & 2: 6/19 - 6/29 No samples collected								
Stratum 3: 6/30 - 7/06 Sampling Dates: 6/30 - 7/06								
Female:	Number in Sample:	1	7	51	8	2	0	69
	Estimated % of Escapement:	0.8	5.3	38.6	6.1	1.5	0.0	52.3
	Estimated Escapement:	8	53	385	60	15	0	521
Male:	Number in Sample:	2	4	50	7	0	0	63
	Estimated % of Escapement:	1.5	3.0	37.9	5.3	0.0	0.0	47.7
	Estimated Escapement:	15	30	378	53	0	0	476
Total:	Number in Sample:	3	11	101	15	2	0	132
	Estimated % of Escapement:	2.3	8.3	76.5	11.4	1.5	0.0	100.0
	Estimated Escapement:	23	83	763	113	15	0	997
	Standard Error:	13	24	37	28	11	0	
Stratum 4: 7/07 - 7/13 Sampling Dates: 7/8 - 7/10, 7/12 & 7/13								
Female:	Number in Sample:	0	1	6	3	0	0	10
	Estimated % of Escapement:	0.0	2.8	16.7	8.3	0.0	0.0	27.8
	Estimated Escapement:	0	29	174	87	0	0	290
Male:	Number in Sample:	0	1	23	1	0	1	26
	Estimated % of Escapement:	0.0	2.8	63.9	2.8	0.0	2.8	72.2
	Estimated Escapement:	0	29	668	29	0	29	755
Total:	Number in Sample:	0	2	29	4	0	1	36
	Estimated % of Escapement:	0.0	5.6	80.6	11.1	0.0	2.8	100.0
	Estimated Escapement:	0	58	842	116	0	29	1,045
	Standard Error:	0	40	70	56	0	29	
Stratum 5: 7/14 - 7/20 Sampling Dates: 7/14 - 7/20								
Female:	Number in Sample:	0	1	26	9	6	0	42
	Estimated % of Escapement:	0.0	0.9	23.9	8.3	5.5	0.0	38.5
	Estimated Escapement:	0	5	126	44	29	0	204
Male:	Number in Sample:	0	5	57	4	1	0	67
	Estimated % of Escapement:	0.0	4.6	52.3	3.7	0.9	0.0	61.5
	Estimated Escapement:	0	24	277	19	5	0	325
Total:	Number in Sample:	0	6	83	13	7	0	109
	Estimated % of Escapement:	0.0	5.5	76.1	11.9	6.4	0.0	100.0
	Estimated Escapement:	0	29	403	63	34	0	529
	Standard Error:	0	12	22	16	12	0	

(Continued)

Appendix 6.-(Continued).

		Brood Year and Age Group						
		1993	1992	1991	1990	1989		
		1.1	1.2	1.3	1.4	1.5	2.4	Total
Stratum 6: 7/21 - 7/27 Sampling Dates: 7/21, 7/22 & 7/24 - 7/27								
Female:	Number in Sample:	0	0	6	6	2	0	14
	Estimated % of Escapement:	0.0	0.0	16.2	16.2	5.4	0.0	37.8
	Estimated Escapement:	0	0	16	16	5	0	37
Male:	Number in Sample:	1	1	16	4	1	0	23
	Estimated % of Escapement:	2.7	2.7	43.2	10.8	2.7	0.0	62.2
	Estimated Escapement:	3	3	42	11	3	0	61
Total:	Number in Sample:	1	1	22	10	3	0	37
	Estimated % of Escapement:	2.7	2.7	59.5	27.0	8.1	0.0	100.0
	Estimated Escapement:	3	3	58	26	8	0	98
	Standard Error:	3	3	8	7	4	0	
Stratum 7: 7/28 - 8/03 Sampling Date: 7/28, 7/29, 8/31 & 8/03								
Female:	Number in Sample:	0	0	3	0	1	0	4
	Estimated % of Escapement:	0.0	0.0	17.6	0.0	5.9	0.0	23.5
	Estimated Escapement:	0	0	10	0	3	0	13
Male:	Number in Sample:	1	4	7	1	0	0	13
	Estimated % of Escapement:	5.9	23.5	41.2	5.9	0.0	0.0	76.5
	Estimated Escapement:	3	13	22	3	0	0	41
Total:	Number in Sample:	1	4	10	1	1	0	17
	Estimated % of Escapement:	5.9	23.5	58.8	5.9	5.9	0.0	100.0
	Estimated Escapement:	3	13	32	3	3	0	54
	Standard Error:	3	6	7	3	3	0	
Strata 8 - 12 Combined: 8/04 - 9/07 Sampling Dates: 8/04, 8/06 - 8/08, 8/20, 8/21 & 9/06								
Female:	Number in Sample:	0	0	1	3	0	0	4
	Estimated % of Escapement:	0.0	0.0	11.1	33.3	0.0	0.0	44.4
	Estimated Escapement:	0	0	6	19	0	0	25
Male:	Number in Sample:	0	0	5	0	0	0	5
	Estimated % of Escapement:	0.0	0.0	55.6	0.0	0.0	0.0	55.6
	Estimated Escapement:	0	0	32	0	0	0	32
Total:	Number in Sample:	0	0	6	3	0	0	9
	Estimated % of Escapement:	0.0	0.0	66.7	33.3	0.0	0.0	100.0
	Estimated Escapement:	0	0	38	19	0	0	57
	Standard Error:	0	0	10	10	0	0	

(Continued)

Appendix 6.-(Continued).

		Brood Year and Age Group						
		1993	1992	1991	1990	1989		
		1.1	1.2	1.3	1.4	1.5	2.4	Total
Strata 13 & 14: 9/08 - 9/16 No samples collected								
Strata 3 - 12: 6/30 - 9/07 Sampling Dates: 6/30 - 9/06								
Female:	Number in Sample:	1	9	93	29	11	0	143
	% Females in Age Group:	0.7	8.0	65.8	20.7	4.8	0.0	100.0
	Estimated % of Escapement:	0.3	3.1	25.8	8.1	1.9	0.0	39.2
	Estimated Escapement:	8	87	717	226	53	0	1,090
	Estimated Design Effects:	0.924	1.810	1.536	1.843	0.641		1.649
Male:	Number in Sample:	4	15	158	17	2	1	197
	% Males in Age Group:	1.2	5.9	83.9	6.8	0.4	1.7	100.0
	Estimated % of Escapement:	0.8	3.6	51.0	4.1	0.3	1.0	60.8
	Estimated Escapement:	21	99	1,418	115	8	29	1,690
	Estimated Design Effects:	0.765	1.559	1.727	1.493	2.954		1.649
Total:	Number in Sample:	5	24	251	46	13	1	340
	Estimated % of Escapement:	1.0	6.7	76.8	12.3	2.2	1.0	100.0
	Estimated Escapement:	28	186	2,136	341	60	29	2,780 *
	Standard Error:	14	49	83	65	17	29	
	Estimated Design Effects:	0.803	1.683	1.704	1.740	1.612		

* 175 fish that were counted through the weir during strata 1 through 3 and strata 11 through 14 are not included in this total.

Appendix 7.-Estimated age and sex composition of weekly coho salmon escapement through the East Fork Andreafsky River weir, Alaska, 1996.

		Brood Year and Age Group			
		1993	1992	1991	
		1.1	2.1	3.1	Total
Strata 1 - 7: 6/19 - 8/03 No samples collected					
Stratum 8: 8/04 - 8/10 Sampling Dates: 8/06 - 8/08					
Female:	Number in Sample:	0	9	0	9
	Estimated % of Escapement:	0.0	45.0	0.0	45.0
	Estimated Escapement:	0	115	0	115
Male:	Number in Sample:	0	11	0	11
	Estimated % of Escapement:	0.0	55.0	0.0	55.0
	Estimated Escapement:	0	140	0	140
Total:	Number in Sample:	0	20	0	20
	Estimated % of Escapement:	0.0	100.0	0.0	100.0
	Estimated Escapement:	0	255	0	255
	Standard Error:	0	0	0	
Stratum 9: 8/11 - 8/17 Sampling Dates: 8/13 - 8/15					
Female:	Number in Sample:	2	13	0	15
	Estimated % of Escapement:	6.1	39.4	0.0	45.5
	Estimated Escapement:	34	224	0	259
Male:	Number in Sample:	0	18	0	18
	Estimated % of Escapement:	0.0	54.5	0.0	54.5
	Estimated Escapement:	0	310	0	310
Total:	Number in Sample:	2	31	0	33
	Estimated % of Escapement:	6.1	93.9	0.0	100.0
	Estimated Escapement:	34	535	0	569
	Standard Error:	24	24	0	
Stratum 10: 8/18 - 8/24 Sampling Date: 8/20 - 8/22					
Female:	Number in Sample:	0	32	0	32
	Estimated % of Escapement:	0.0	38.6	0.0	38.6
	Estimated Escapement:	0	591	0	591
Male:	Number in Sample:	0	51	0	51
	Estimated % of Escapement:	0.0	61.4	0.0	61.4
	Estimated Escapement:	0	942	0	942
Total:	Number in Sample:	0	83	0	83
	Estimated % of Escapement:	0.0	100.0	0.0	100.0
	Estimated Escapement:	0	1,533	0	1,533
	Standard Error:	0	0	0	

(Continued)

Appendix 7.-(Continued).

		Brood Year and Age Group			
		1993	1992	1991	
		1.1	2.1	3.1	Total
Stratum 11: 8/25 - 8/31 Sampling Dates: 8/29 - 8/31					
Female:	Number in Sample:	2	47	0	49
	Estimated % of Escapement:	1.9	44.3	0.0	46.2
	Estimated Escapement:	76	1,790	0	1,866
Male:	Number in Sample:	2	54	1	57
	Estimated % of Escapement:	1.9	50.9	0.9	53.8
	Estimated Escapement:	76	2,056	38	2,170
Total:	Number in Sample:	4	101	1	106
	Estimated % of Escapement:	3.8	95.3	0.9	100.0
	Estimated Escapement:	152	3,846	38	4,036
	Standard Error:	75	84	38	
Stratum 12: 9/01 - 9/07 Sampling Dates: 9/04 & 9/06					
Female:	Number in Sample:	0	39	0	39
	Estimated % of Escapement:	0.0	52.7	0.0	52.7
	Estimated Escapement:	0	722	0	722
Male:	Number in Sample:	1	34	0	35
	Estimated % of Escapement:	1.4	45.9	0.0	47.3
	Estimated Escapement:	19	629	0	648
Total:	Number in Sample:	1	73	0	74
	Estimated % of Escapement:	1.4	98.6	0.0	100.0
	Estimated Escapement:	19	1,351	0	1,370
	Standard Error:	19	19	0	
Strata 13 & 14: 9/08 - 9/16 No samples collected					
Strata 11 - 13: 8/20 - 9/09 Sampling Dates: 8/21 - 9/08					
Female:	Number in Sample:	4	140	0	144
	% Females in Age Group:	3.1	96.9	0	100.0
	Estimated % of Escapement:	1.4	44.3	0	45.8
	Estimated Escapement:	111	3,442	0	3,552
Male:	Number in Sample:	3	168	1	172
	% Males in Age Group:	2.2	96.8	0.9	100.0
	Estimated % of Escapement:	1.2	52.5	0.5	54.2
	Estimated Escapement:	95	4,078	38	4,211
Total:	Number in Sample:	7	308	1	316
	Estimated % of Escapement:	2.6	96.9	0.5	100.0
	Estimated Escapement:	205	7,520	38	7,763 *
	Standard Error:	81	89	38	

* 274 fish that were counted through the weir during strata 1 through 7 and strata 13 and 14 are not included in this total.